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UPDATING A GAME'S GRAPHICS FROM 2D SPRITES TO 3D MODELS

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ABSTRACT

The goal of this thesis was to go through the author's own work when recreating 3D models for the game "Spooky's Jumpscare Mansion: HD Renovation" created by Albino Moose Games and comparing it to the possible techniques used in another game's remake, in order to define what concepts to keep in mind when recreating existing assets, as well as to find out what issues may arise in doing so.

The thesis includes explanations for some basic concepts within 3D modelling, and looked into what difficulties may arise from remaking a game's assets. Afterwards it analysed assets from the game "System Shock: Enhanced Edition" and its remake both published by Nightdive Studios and compared them in order to figure out the artists' intent when recreating assets. These results were then compared to the author's own work, to see if similar techniques had been used.

The outcome of this was that both the author and the developers of System Shock's remake had kept similar things in mind when recreating assets, and that there are numerous matters to keep in mind when recreating 2D assets into 3D, such as shapes and silhouettes, polygon count and topology, and animation.

Keywords: 2D, 3D, Remaster, Remake, Video Game, Polygon, Texture, Unwrapping, Animation, Polycount

CONTENTS

1 INTRODUCTION

This thesis is written on the topic of updating a game's models from two-dimensional images into three-dimensional models. Particularly focusing on a few techniques and topics to keep in mind during the process, such as overall design, silhouette, polygon count as well as texture size.

Firstly, the thesis explains a few basic topics in 3D modelling, such as topology, polygon count, and texture UV mapping. Then, the thesis discusses what to keep in mind when recreating higher fidelity versions of existing video game assets in general, as well as what issues and difficulties this may involve.

Afterwards, the thesis discusses the game "System Shock" as well as its remake's demo, as the original game uses two-dimensional sprites which have been adapted into 3D in its remake. Finally, the thesis covers the author's own work and process for the title "Spooky's Jumpscare Mansion: HD Renovation", which involves creating textured, game ready 3D models out of provided two-dimensional sprites.

Spooky's Jumpscare Mansion: HD Renovation is a horror video game released in 2017 by Albino Moose Games. It is a recreated version of the game "Spooky's Jumpscare Mansion", remade in a new engine. The original game had been created in GameMaker, while the remake has been created using Unity. The change from GameMaker to Unity allows for more liberal use of 3D assets within the game, which the author had been hired to create based on the original spritework found in the GameMaker version.

During the process, Blender is used for the creation of the 3D models as well as UV mapping, and Substance Painter is used for painting the model's textures. After the assets have been created the models will finally be imported into Unity, the game engine used for the game.

2 ASSET CREATION AND RECREATION

2.1 Topology & Polygon Count

When creating 3D assets for modern games, it is common to create a “high poly” and a “low poly” model of the same asset. High poly means that the polygon count and topology in the model is high and unoptimized for real time rendering within games. A low poly model is a 3D model that has a lower polygon count, and its topology is optimized for use in a game engine. (FlippedNormals 2021.) Depending on the use of the model, the low poly model’s topology may also be optimized for animation as well. When creating game assets, a high poly model is used for baking details into the low poly model’s texture maps, such as a normal map, an ambient occlusion map, and a height map. These texture maps are used in the asset’s material to fake detail that does not exist in the model’s actual geometry. This is easier for the game engine and computer to process than a higher polygon model.

2.2 UV Mapping

When creating UV maps, you place seams into the model in order to unwrap it into a 1x1 square image (FlippedNormals 2021). One may think of it as origami, or papercraft, except in reverse. Instead of folding a flat object and closing its seams to create something three dimensional, one creates seams on a 3D object to unfold it into a flat shape. These flat shapes, UV islands, ideally have as little stretching and deformation as possible. In organic shapes some stretching may be inevitable, however. And in other cases, stretching or deformation may be used to make the later texturing an easier task.

2.3 Keeping Designs Recognizable

When remaking an existing game’s assets, it is important to keep them recognizably similar to the originals. For game assets with less fidelity, one way of achieving this is to attempt to create what fans of the original would remember them looking like “in their mind’s eye” (Kiem et al. 2018).

The asset's visual design itself is not the only thing that affects the recognizability. The animation style must also be kept intact when remaking assets. In 3D modeling, the animation style must be kept in mind during the creation of the model, to allow for the intended amount of expression and animation that the asset will have. Key issues to keep in mind are the detail and base expression of the model itself, as well as the model's topology. (Kiem et al. 2018.) Should a model's topology not allow for the intended animations, this may result in unwanted deformation.

Another way of achieving this is to directly take the original asset, and to then build on top of it by adding details that could not originally be there due to technical limitations of the era or type of asset. (Kiem et al. 2018.)

2.4 Possible Issues

Many issues may arise during the recreation of assets, such as individual perception of the original asset causing disagreement between artists. The original design may also have not been perceived by the end consumer as the artist had intended, causing a mismatch between the player's memory and the remade version of the asset. (Kiem et al. 2018.) This is especially true with lower fidelity assets, as seen in older games.

In some cases, seemingly small changes in design or animation may affect gameplay. A player may recognize a specific frame of animation as the time when an attack lands, for example (Kiem et al. 2018). Changes in visual design can also affect the actual visibility of the asset, making it easier or more difficult to differentiate from the environment. If a game's assets are inconsistent with graphical options, this may cause some players to have an advantage if the player model is, for example, more visible on a lower graphics setting than a higher one.

Technical limitations can also be an issue. Not necessarily of the development team's equipment, but that of the end user. It must be considered whether the asset is intended for a game playable only on higher end gaming hardware, such

as a personal computer or a modern game console, or a mobile device such as a handheld console or a smartphone (Kontinen 2020). Personal computers are also not necessarily higher end machines, as many people cannot afford more powerful, expensive components. Because of this, proper asset optimization is important when creating assets for games.

3 SYSTEM SHOCK ANALYSIS

As part of this thesis, the video game titled “System Shock” (1994) as well as its remake (2023) have been selected for analysis. This title was selected as the original game uses two dimensional images known as “sprites” for many of its assets. During the analysis, the author attempts to consider the methods the remake’s artists may have used when creating the remade assets and environments, as well as the intent.

In the title’s remake, many of these assets have been reimagined and remade into three dimensional models. Some assets have seen more drastic changes than others.

3.1 Environment

3.1.1 Beginning Room

Figure 1. Screenshot of the opening room of System Shock: Enhanced Edition (Nightdive Studios 2015)

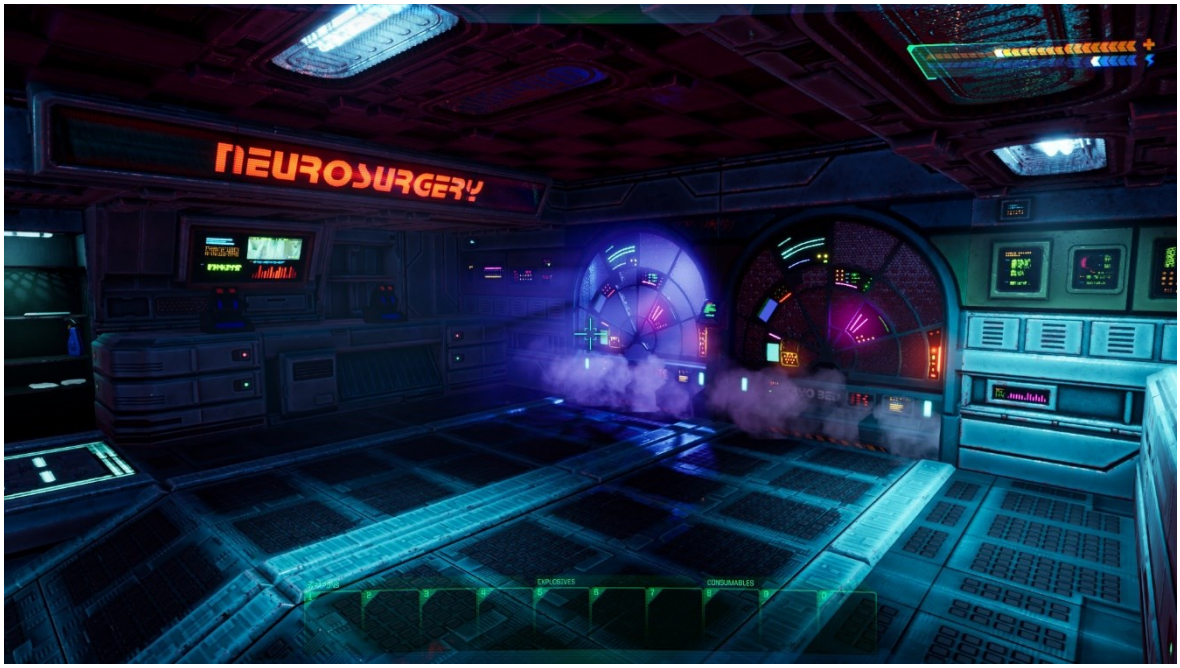

Figure 2. Screenshot of the opening room of System Shock Remake (Nightdive Studios 2023)

Being the first room the player sees in the original game, this section may be one of the most important rooms in a remake to be recognizable for fans of the original. As seen in Figures 1 and 2, the opening room has seen drastic changes. Notably, the room is much larger and has added details. However, it remains recognizable as the same room.

Windows in the wall have kept the same shape and details. Both rooms have a “Neurosurgery” sign, though the font design has changed in the remade version. The walls are seemingly identical to the original version at first glance, however they have added detail due to having a higher texture resolution as well as utilizing physics-based rendering, where surfaces of models react to light in a realistic manner.

The key landmark in this case is the windows. The overall design of them has stayed essentially the same, with even neon lights being on the exact same spots.

3.1.2 Restoration Station

Figure 3. Screenshot of a restoration station in System Shock: Enhanced Edition (Nightdive Studios 2015)

Figure 4. Screenshot of a restoration station in System Shock Remake (Nightdive Studios 2023)

In the restoration station, quite a bit has changed. The station is no longer a cube shaped cage, but rather indented into the wall. Detail and depth within the model itself have been added. The humanoid-shaped indent has been kept mostly intact, however the elements surrounding it have either been changed or omitted entirely.

The circles in the original have been omitted, though the half circles in the remade version may be intended to be their replacement. The screens and wiring of the original have been omitted, likely to create a cleaner look. The overall layout of the room itself mostly remains the same, the remake even containing a lowered ceiling in the position of the original's cage. Smaller details have been changed or added, such as the activation lever being on a slanted console rather than flush with the wall.

3.1.3 Security Cameras

Figure 5. Screenshot of a security camera in System Shock: Enhanced Edition (Nightdive Studios 2015)

Figure 6. Screenshot of a security camera in System Shock (Nightdive Studios 2023)

As seen in Figures 5 and 6, the differences between the original and remade asset are quite drastic. However, the original model does not have much detail to build on. The security cameras are also one of the few smaller assets within the original game to be rendered in real time as a 3D model, as opposed to a 2D sprite. The newer asset is for the most part redesigned completely, with the main

shared detail being the red light on its lense. The overall shape is rounder, and the artist has designed a means for the camera to be attached to the ceiling.

3.2 Characters

Figure 7. Screenshot of a Humanoid Mutant enemy in System Shock: Enhanced Edition (Nightdive Studios 2015)

As seen in Figure 3, the original System Shock, enemies and other non-playable characters (NPCs) were portrayed by using animated two-dimensional sprites. To make them look more three dimensional, the NPCs have several animations for the same actions, for various perspective from the player's view, such as in front, from the side, from the back, and so on.

Figure 8. Screenshot of a Humanoid Mutant enemy in System Shock Remake (Nightdive Studios 2023)

When comparing Figure 3 to Figure 4, the design has overall stayed the same. Details have been added, such as blood on the hands and mouth. A shoulder pad has been added to the jumpsuit.

The silhouette has not changed much, the character's proportions have stayed similar. The key details to this design are the proportions & silhouette, the jumpsuit, as well as the eyes. Smaller details, such as the jumpsuit having been torn open from the mutant's righthand side, have also been kept intact.

3.3 Conclusion of Analysis

From the analysis of the two games, it can be seen that keeping the same shape language is crucial to keeping a recognizable design between the iterations. It

may also be important to select key details seen in the original version, and to either keep them in the overall design or to add on to them. It may also be necessary to add detail to where there is none, but not to completely replace any existing elements (Kiem et al. 2018).

4 WORK ON SPOOKY'S JUMPSCARE MANSION

The author had been hired to remake 2D sprites from the game “Spooky’s Jumpscare Mansion: HD Renovation” into updated 3D models. A variety of methods had been used to achieve this. Requirements for 3D assets were as follows:

- Less than 500 quad polygons per model (PlayStation 2-era models)
- 256x256 pixel texture maps
- Base colour only

The polygon count for models is rather low compared to modern video games. One reasoning behind this is that a lower polygon count is fitting for the game’s visual style. A lower polygon count is also beneficial to a game’s performance, 3D models with a higher number of polygons take considerably more processing power from the computer’s graphics card and take up more system memory (Le 2022). This is also the case with higher resolution texture maps. It is important to note that many assets appear on screen most of the time during gameplay, many of them being the same assets repeated. Were the assets to be improperly optimized and be repeated multiple times within a level, the game may run at a considerably lower framerate and require higher end hardware than intended. There is also no requirement for texture maps used in physics-based rendering, such as normal maps, roughness maps and metallic maps. This is due to the game’s visual style demanding hand painted textures, which can be seen in older video games.

4.1 Direct Remake

During the project, the amount of creative freedom taken by the author varied. In some cases, the overall design of the original sprites could be directly transferred

to the 3D model. In other cases the original sprite was too abstract, and some creative liberties had to be taken in order to make an asset visually appealing as a 3D model.

4.1.1 Door

Figure 9. Original door & chain sprite (Albino Moose Games 2017)

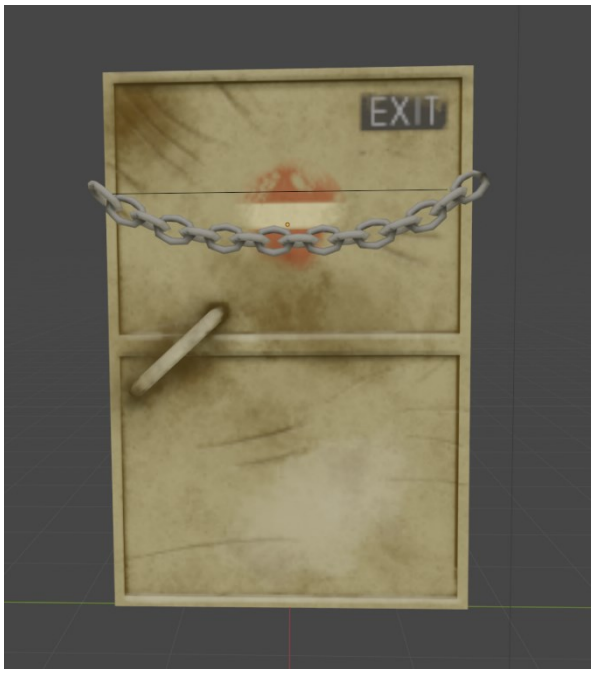

Figure 10. Remade door model & chain

With this door example seen in Figure 5, the author placed the sprite into the 3D modeling program and modeled on top of it. Modeling on top of the existing sprite assisted in keeping the asset's proportions as similar as possible, so that

implementing the newer version of the asset would be seamless. The door's handle had not been three dimensional in the original asset, and thus had to be modeled. The chain had also been remade into a 3D model. After modeling was complete, the asset was UV unwrapped and imported into Substance Painter for texturing. The texture had been painted by hand to closely resemble the original spritework.

4.1.2 Guard Rail

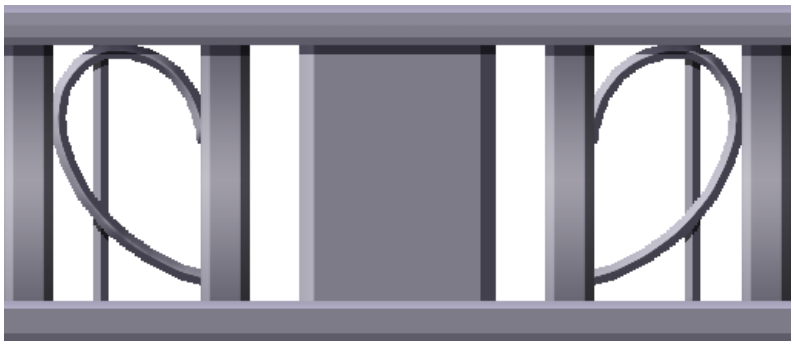

Figure 11. Rail sprite (Albino Moose Games 2017)

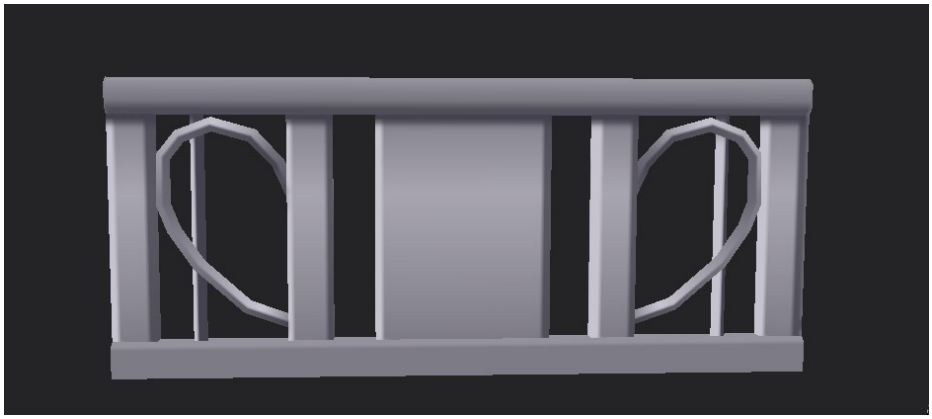

Figure 12. Remade rail

With the rail asset seen in Figures 11 and 12, the process was similar to what had been done with the door asset. The original sprite was imported into the 3D modeling program, and the modeling was done on top of the sprite itself to keep the shape nearly identical. After the rail was modeled and unwrapped, its textures were for the most part created using gradients within Substance Painter. This was to keep the clean, smooth look of the material intact.

4.2 Abstract Sprites

In some situations, the original 2D sprite has an abstract object, which takes more work to transfer into a 3D model. Abstract in this case means an object that has shapes and forms that would not make sense in three dimensions. As an example, a chandelier object has been selected.

Figure 13. Chandelier sprite (Albino Moose Games 2017)

As seen in Figure 9, the chandelier sprite does not have clear three-dimensional forms, however, distinctive details could be pinpointed to transfer to the 3D model: the candles and the curved candle holders, the hanging beads, the silhouette of the central piece as well as the hanging crystals. The silhouette of the centerpiece could also be used in the 3D version’s shape.

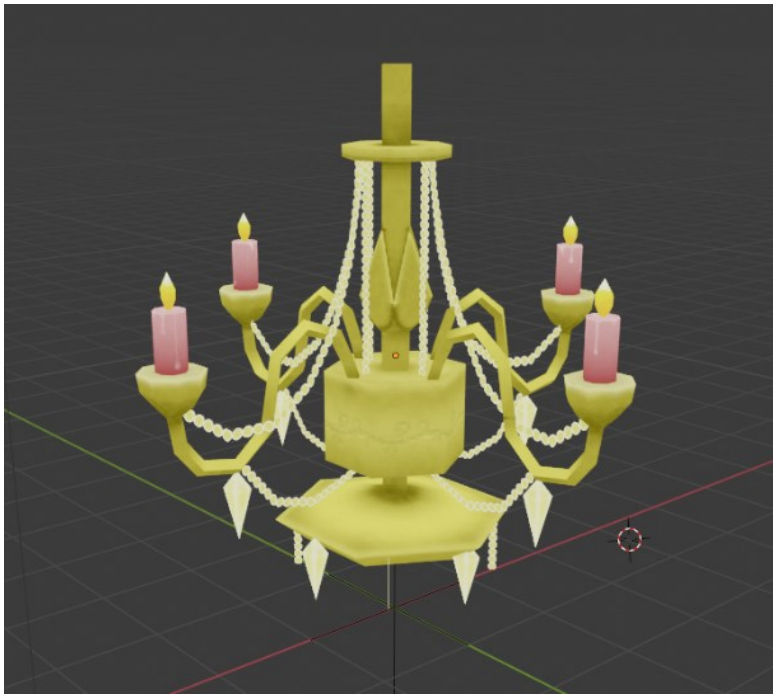

Figure 14. Chandelier model

When creating the 3D version of the chandelier, it was important to keep the distinct details. Keeping the same silhouette and primary shapes of the original is also important (Kiem et al. 2018). In this chandelier, details from the original sprite had been interpreted as being from a side view, and had been modeled as such. The candle arms had been modeled as seen in the original sprite, and then mirrored in both the X and Y axes.

The hanging beads visible on the sprite would increase the model's total polygon count above the maximum, and thus had to be created using a repeating texture map on polygons. Several reoccurring pieces of the model also share the same UV piece, allowing for more space to be used within the 256x256 texture map. These pieces include the candles, the hanging beads, as well as the hanging crystals.

4.3 Reusing Sprite as Texture

In some cases, the original 2D sprite artwork is perfect for the project, and only requires additional detail and depth from a 3D model. In situations such as this, it can save quite a bit of time to use the original artwork as a texture. Reusing the

original sprite as a texture also ensures that the asset will be recognized as the same asset, only with a higher amount of detail.

4.3.1 Frozen Person

Figure 15. Original frozen person (Albino Moose Games 2017)

As the original version of Spooky's Jumpscare Mansion had been made using GameMaker, which did not directly support three dimensional games, some elaborate techniques had to be used to emulate three-dimensional objects within the game. To create the original frozen person seen in Figure 15, the "model" was a pair of two-dimensional sprites, rotated slightly and connected in the middle to seem three dimensional.

Figure 16. 3D model of a frozen man

To add detail and depth to the model, the two sprites first had to be fused in an image editing program. Afterwards, in a 3D program, a plane was created, and the fused sprites were used as its texture. From here on, the plane object was extruded, and loop cuts were added. Areas on the body with more visible light had been pulled outward, while darker areas were pushed back. This was to create more visible depth when viewed from a side angle.

4.3.2 Rock Wall

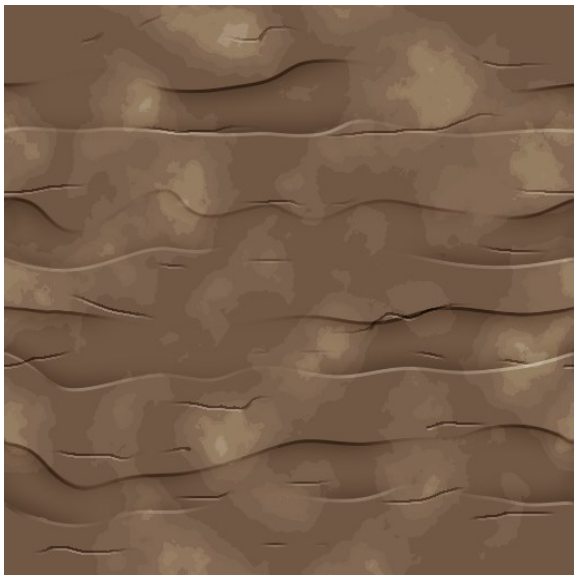

Figure 17. Rock wall texture (Albino Moose Games 2017)

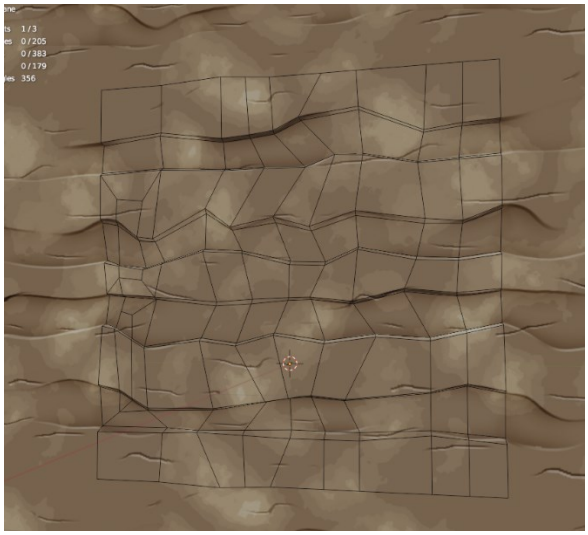

Figure 18. Rock wall model.

Another asset that required more depth was what had originally been a flat texture for a rock wall. The process for this asset was simpler and faster than the frozen person, as the mesh itself did not require much else than loop cutting, moving vertices, and minor optimization. The geometry of the model directly follows the painted lighting on the original texture. The added geometry adds further detail when a player sees the wall in question up close. Something that required attention, however, was that the model was required to loop without visible seams. This requires the top vertices to align with their bottom counterparts in the X and Y axes, and the vertices on the leftmost edge to align with their rightmost counterparts.

4.4 Animation & Cel Shading

Some assets had animations, and thus when creating the 3D models, the animations also were required. In the following example, a cat character is remade into a 3D model, along with its animation of a wagging tail.

Figure 19. Two frames of a cat's idle animation, showing a smear frame (Albino Moose Games 2017)

As seen in Figure 19, the tail wagging animation contains a "smear frame". A smear frame is a technique commonly used in 2D animation to express fast motion, and to simulate motion blur seen in lower framerate camera footage. Similar to 2D animation, in 3D animation this is often emulated by stretching or squashing the 3D model.

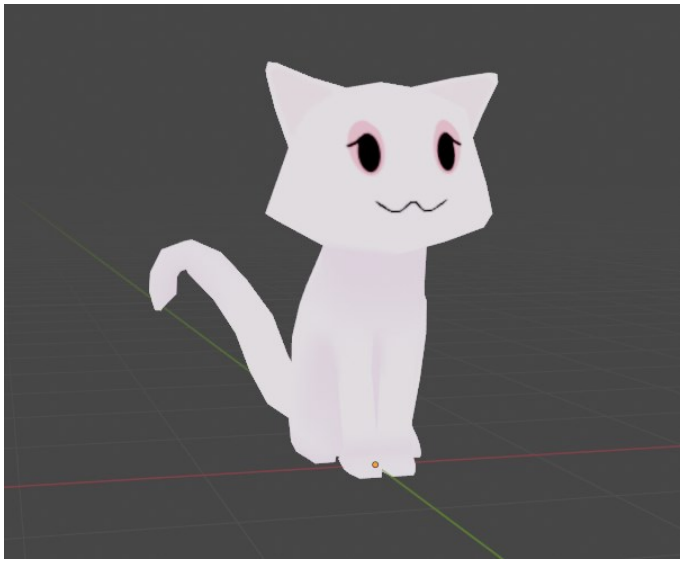

Figure 20. 3D recreation of the cat

Seen in Figure 20, the 3D model of the cat is quite simple and lacks cel shading seen in the original. Cel shading is to be added within the game engine's shaders later. Another way of achieving it would be to have a copy of the model scaled slightly larger, with inverted normals. Normals in this case refer to the direction that a polygon is facing. Inverted normal meaning that the polygons are facing towards inwards towards the object, while the outside remains transparent, akin to how one-way glass would be visible to the human eye with one side being transparent while the other side reflects light.

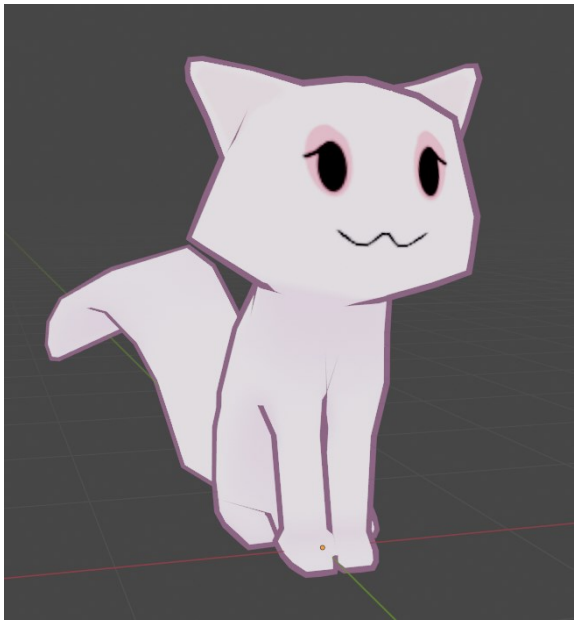

Figure 21. One option of creating cel shading on a model

Were the original model be covered entirely with a slightly larger version of itself that has its normals flipped and using a flat colour as its material, it would create lines on the edges of the model as seen in Figure 21. In the end, this method was not used as it effectively doubles the model's polygon count.

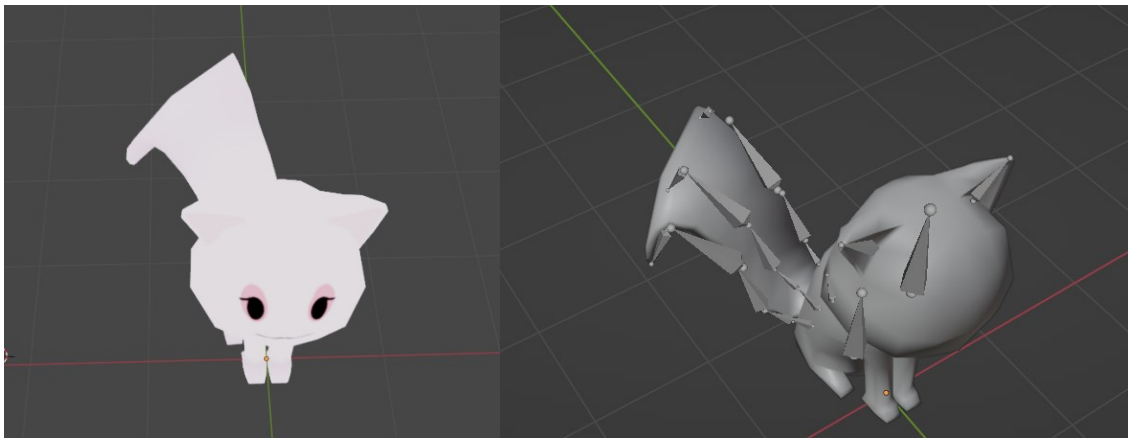

Figure 22. Smear frame in the 3D model and its skeleton

As seen in Figure 22, the smear animation does not contain as much stretching as the original spritesheet. However, the stretching of the tail lasts for more frames than the single frame in the original. With the 3D animation containing a larger number of frames than the original 2D animation,

The stretching has been achieved through having the tail section of the model consist of three sets of bones. One set is the center of the tail, which controls the overall movement of the tail. The other two sets of bones control the stretching of the tail. Moving or rotating the centre set of bones affects the others as well, however, moving the other sets does not affect the position or rotation of the center set.

4.5 Conclusion of Work

Not all of the author's created assets had been showcased in this thesis, the selected ones had been chosen to showcase different possible difficulties or challenges that required to be overcome during the creation of the assets. When compared to previous research, similar methods had been used, such as keeping track of the asset's shapes and silhouette, and deciding which details are

important to keep within the design. These assets are sent to Albino Moose Games, and if they meet the specifications, they will feature in an upcoming update to their game.

5 DISCUSSION AND CONCLUSION

Remaking a 2D asset into 3D may bring a number of challenges, both in visual design as well as technical limitations. There are different aspects to be mindful of, such as polygon count and texture size. This thesis did not discuss whether creating the 3D asset would be more complicated than the creation of the 2D asset. It may not be that one is more complicated than the other, but that both mediums have their own challenges and limitations. While with 2D sprites there is sprite resolution and animation frame amount to take into consideration, with 3D models there is model optimization and animation friendly topology.

The purpose of this thesis was to go over the author’s work, however parts of it had ended up moving away from the topic and becoming more about remaking game assets in general. During the process of creating assets for Spooky’s Jumpscare Mansion: HD Renovation, the author had learned what kind of details to look out for when recreating assets. The author has also improved in creating assets using handpainted textures. With the increase in game remakes in recent years, it may be useful to further research techniques and problems when it comes to recreating a game’s assets.

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